US007221889B2

(12) United States Patent
Patton et al.

(10) **Patent No.: US 7,221,889 B2**

(45) **Date of Patent: May 22, 2007**

(54) **REPLACEABLE DEVELOPER ROLLER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 92 days.

(21) Appl. No.: **11/077,438**

(22) Filed: **Mar. 10, 2005**

(65) **Prior Publication Data**

US 2006/0204275 A1 Sep. 14, 2006

(51) **Int. Cl.**
G03G 15/04 (2006.01)
G03G 15/08 (2006.01)

(52) **U.S. Cl.** **399/119**; 399/286

(58) **Field of Classification Search** 399/110, 399/111, 119, 222, 239, 279, 286

See application file for complete search history.

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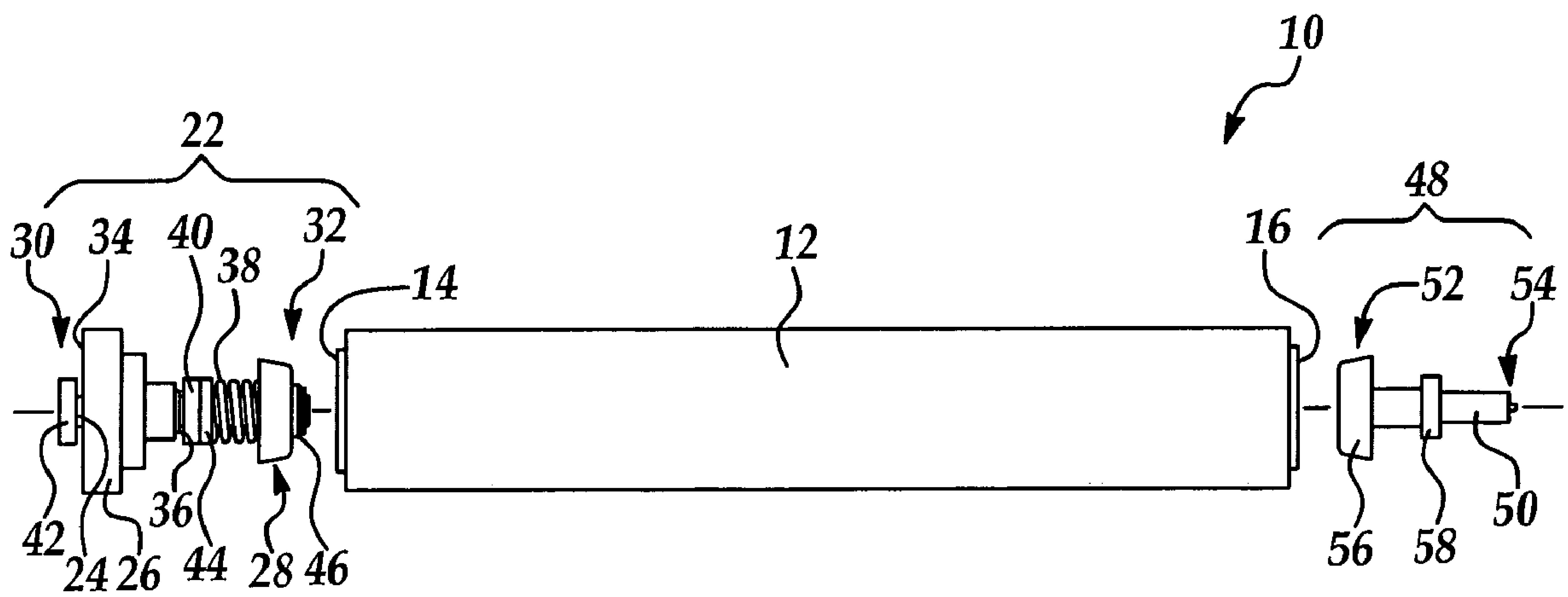
(57) **ABSTRACT**

A replaceable developer roller apparatus is disclosed for a printing device. The apparatus includes a cylindrical developer roller having two opposed ends, and a drive assembly selectively and operatively engageable with one of the opposed ends of the developer roller. The drive assembly includes a shaft having two opposed regions; a gear rotationally fixed to one of the opposed regions of the shaft; and a drive member rotationally fixed to the other of the opposed regions of the shaft, and selectively, axially moveable between an engagement position and a disengagement position. A spindle assembly is engageable with the other of the opposed ends of the developer roller. The spindle assembly includes a spindle assembly shaft and an alignment member rotationally fixed to the spindle assembly shaft.

35 Claims, 3 Drawing Sheets



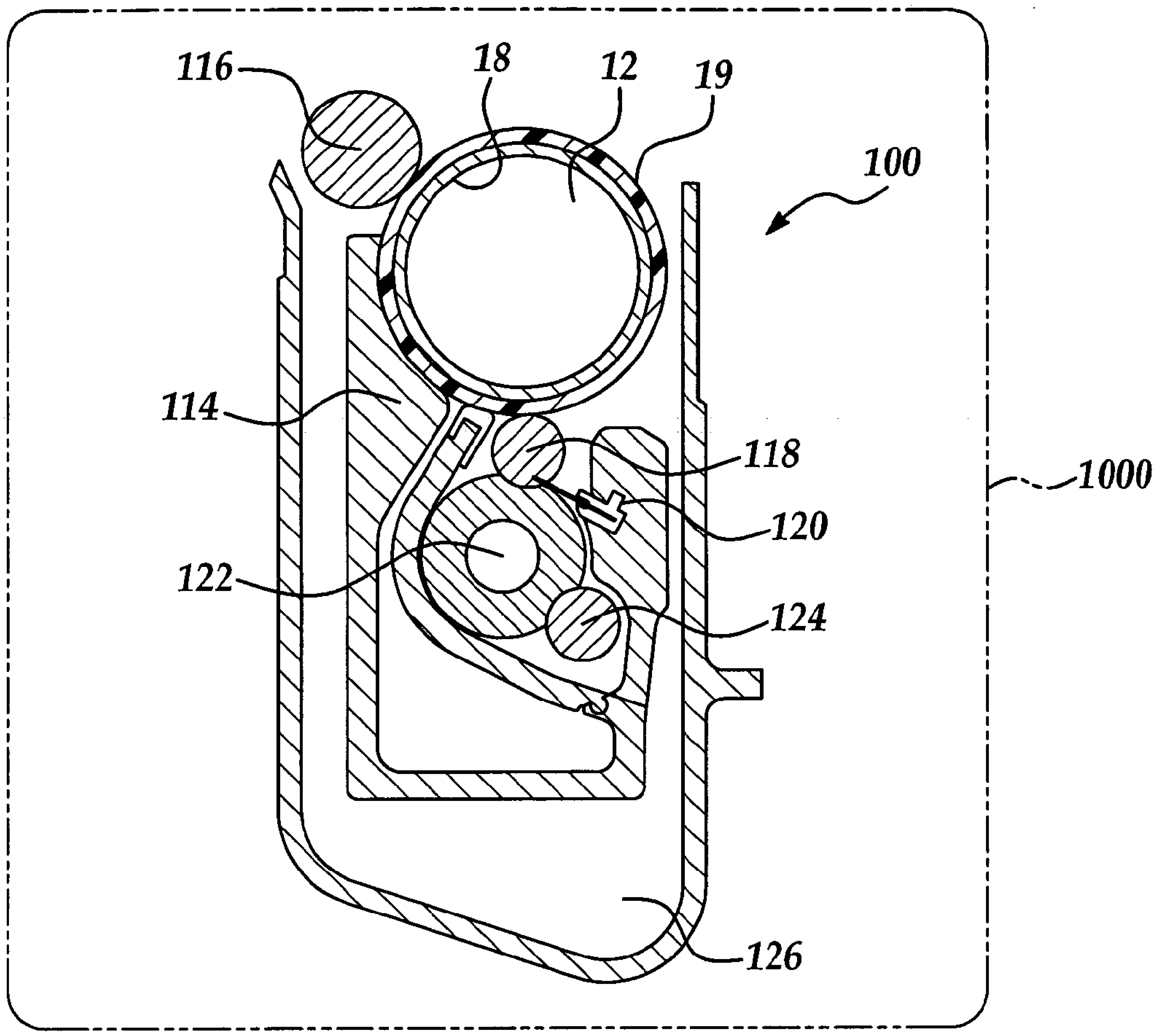


Figure 1

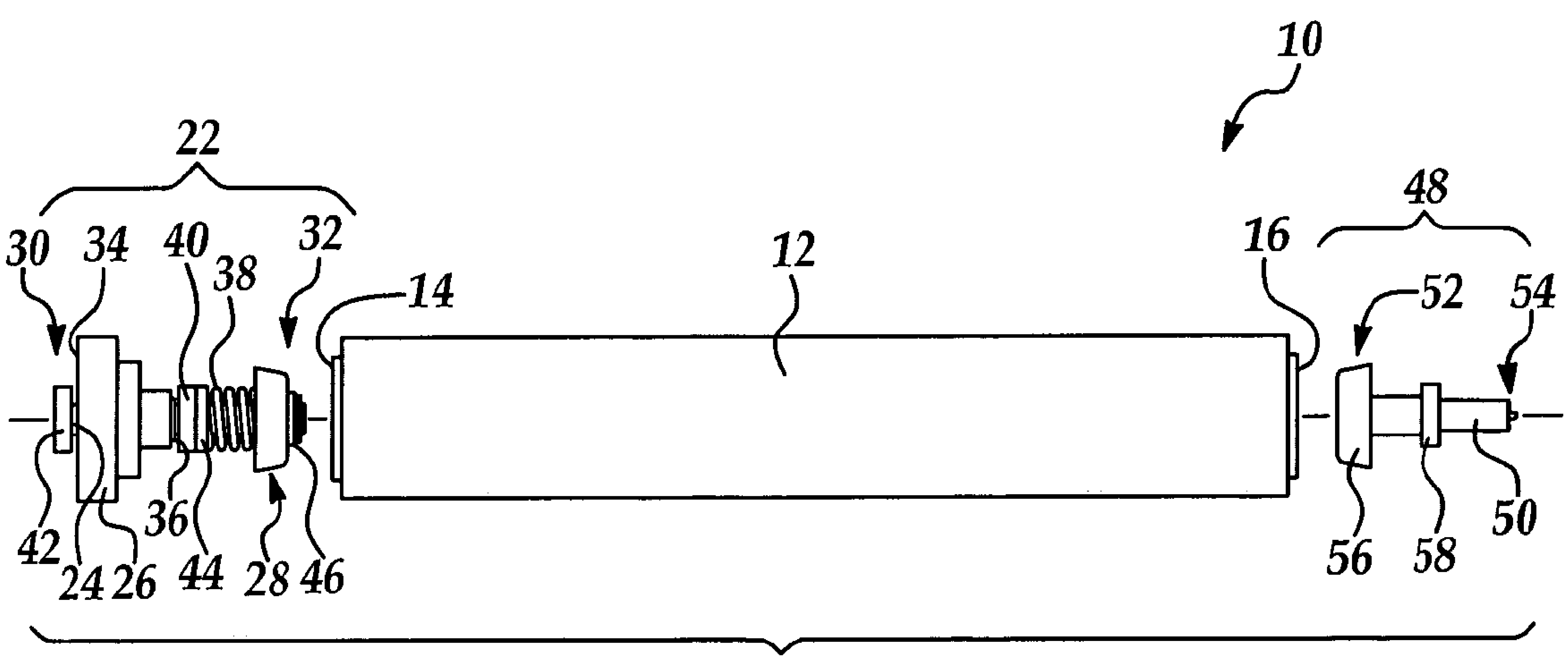


Figure 2

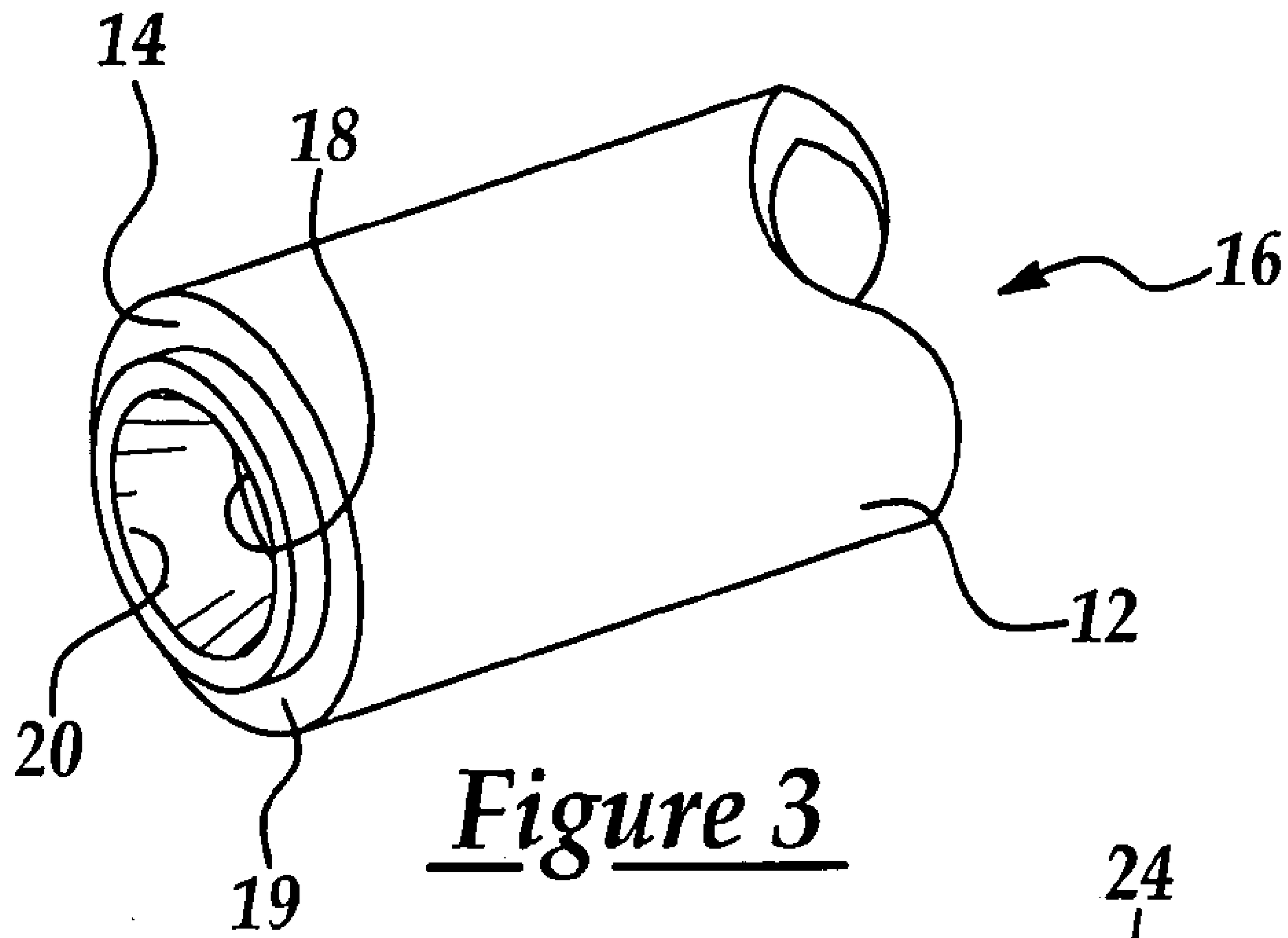


Figure 3

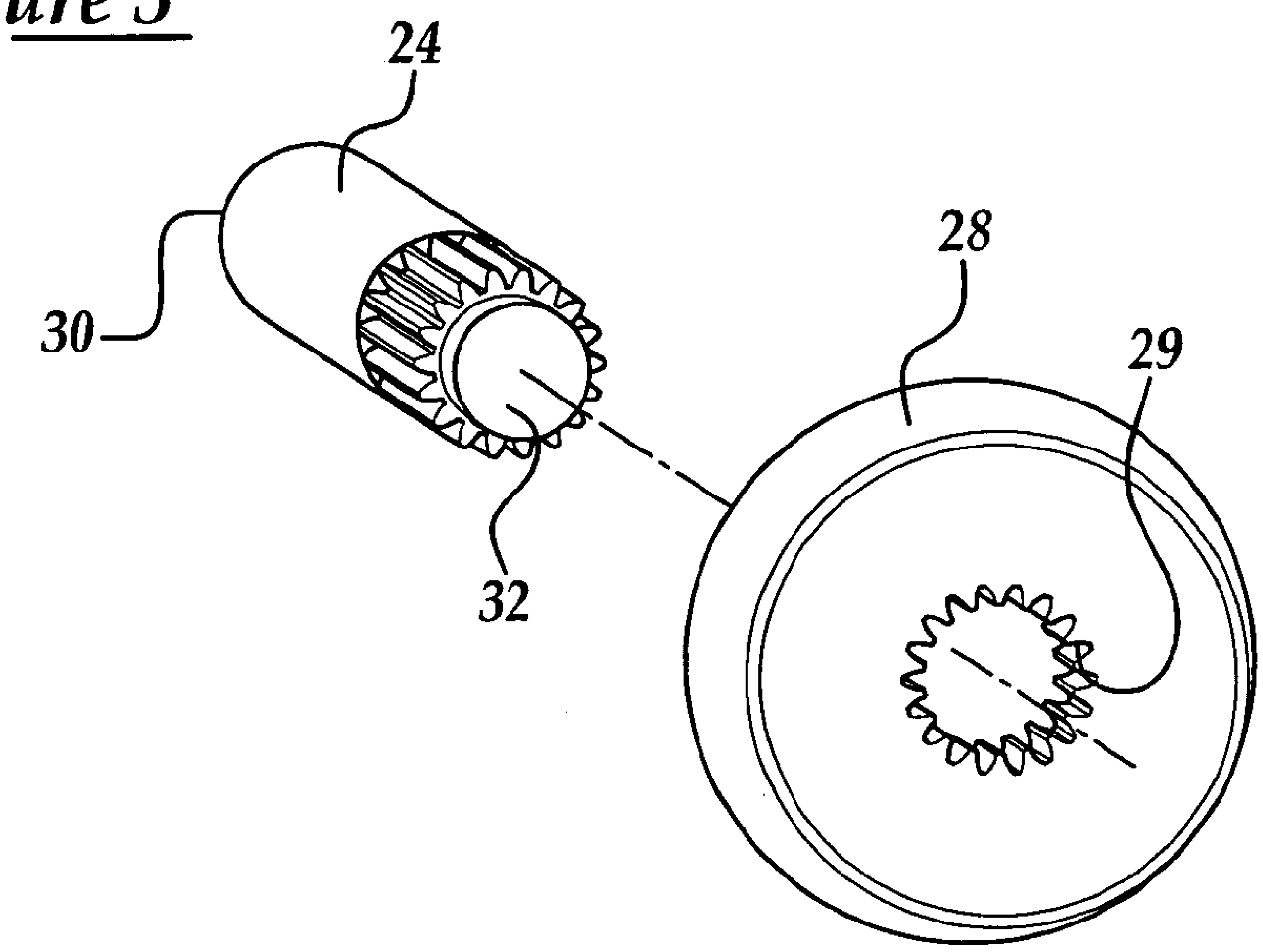


Figure 4

MOVE DRIVE MEMBER AWAY FROM DEVELOPER ROLLER AND COMPRESS SPRING — 60

↓

MOVE DEVELOPER ROLLER OUT OF ENGAGEMENT WITH SPINDLE ASSEMBLY — 62

↓

REMOVE DEVELOPER ROLLER FROM APPARATUS — 64

↓

REPLACE WITH NEW ROLLER BY REVERSING PROCESS — 66

Figure 5

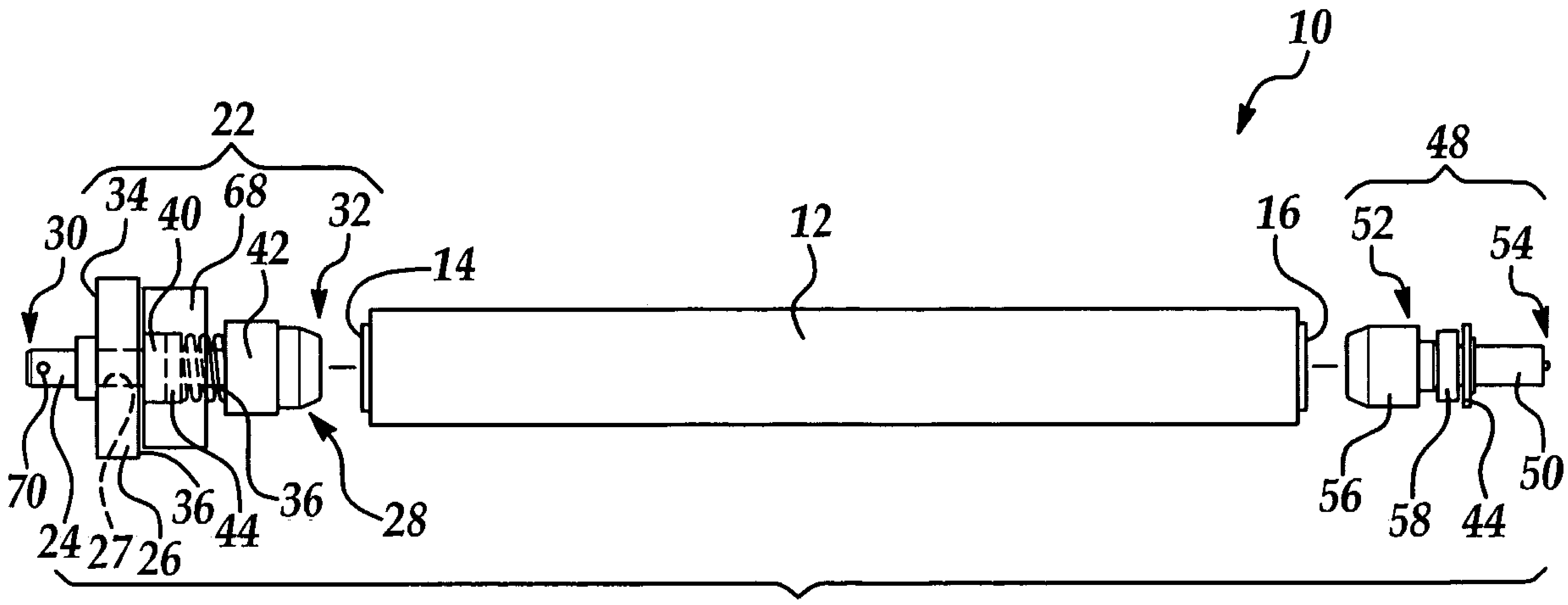


Figure 6

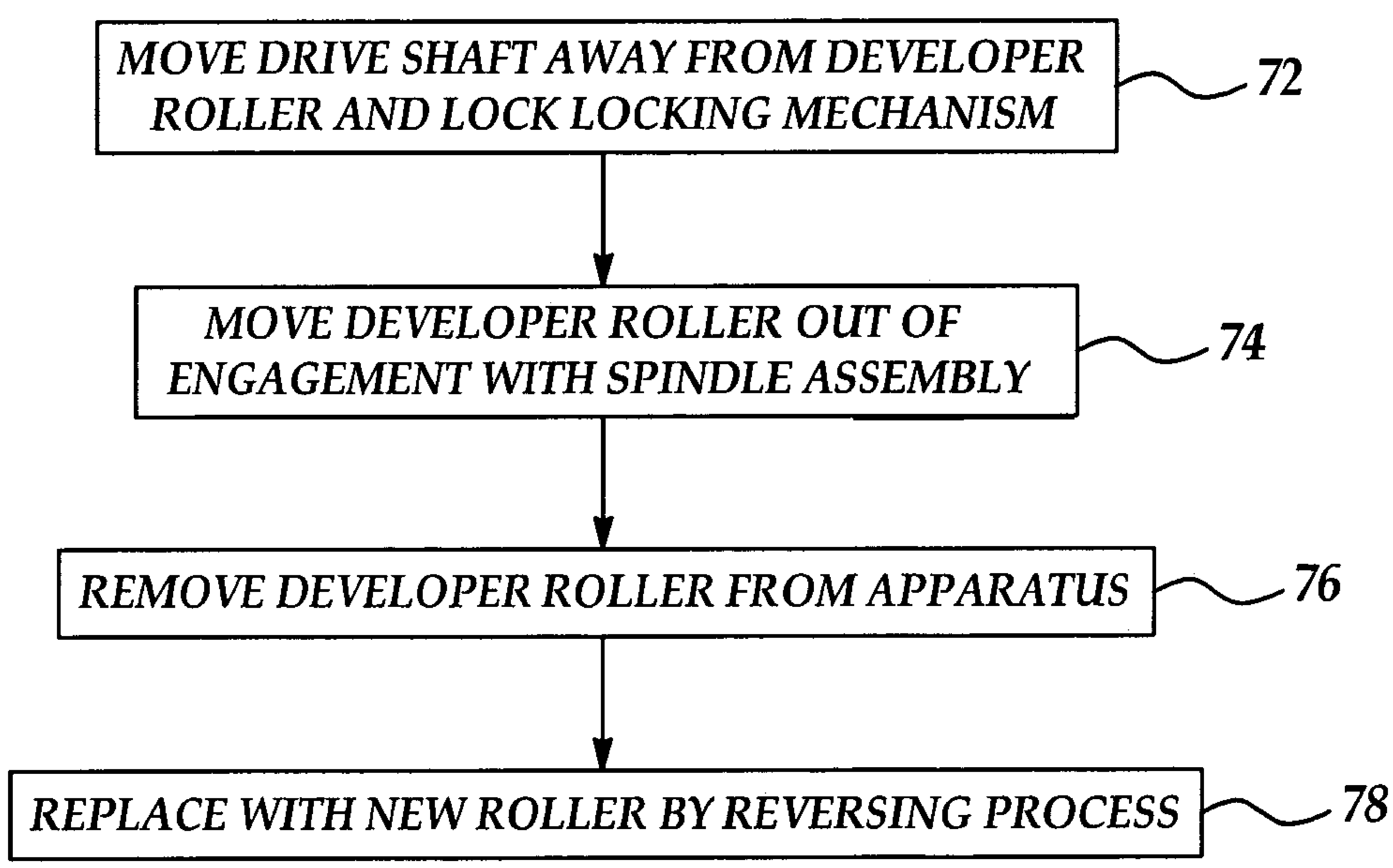


Figure 7

REPLACEABLE DEVELOPER ROLLER

BACKGROUND

The present disclosure relates generally to developer rollers and more particularly to replaceable developer rollers.

A binary ink developer (BID) is a consumable that is often used in a printing device. This consumable is generally made from custom and/or off-the-shelf parts. Failure of a component(s) in this consumable may, in some instances, induce an operator to replace the entire BID. This is due, at least in part, to the relative difficulty of replacing the components within the BID.

One component of the BID is the developer roller. Current developer rollers include a solid aluminum shaft with a urethane layer molded thereon. Generally, the life span of a developer roller may be variable. Potential failures associated with the developer roller may, in some instances, affect the print quality of the BID. As such, operators may be inclined to replace the developer roller itself, however, this is generally not an easy task. The replacement of the developer roller in current binary ink developers includes the potential risk of damaging another component during replacement. Further, as many components generally need to be removed in order to get the developer roller out of the BID, the process would generally be time consuming. Still further, special tools and/or training would likely be used in the process, as there are generally several fasteners that are assembled to a specific torque.

As such, it would be desirable to provide a developer roller that is relatively easily removable from a binary ink developer.

BRIEF DESCRIPTION OF THE DRAWINGS

Objects, features and advantages will become apparent by reference to the following detailed description and drawings, in which like reference numerals correspond to similar, though not necessarily identical components. For the sake of brevity, reference numerals having a previously described function may not necessarily be described in connection with subsequent drawings in which they appear.

FIG. **1** is a cross sectional semi-schematic view of an embodiment of a binary ink developer;

FIG. **2** is an exploded side view of an embodiment of a replaceable developer roller apparatus;

FIG. **3** is a cutaway perspective view of an embodiment of a hollow cylindrical developer roller;

FIG. **4** is an exploded perspective view of an embodiment of a splined drive assembly shaft and a complementarily splined frusto-conical drive member;

FIG. **5** is a flow diagram depicting an embodiment of the method of replacing an embodiment of a developer roller;

FIG. **6** is an exploded side view of an alternate embodiment of a replaceable developer roller apparatus; and

FIG. **7** is a flow diagram depicting an alternate embodiment of the method of replacing an embodiment of a developer roller.

DETAILED DESCRIPTION

Liquid electro photography (LEP) printers generally operate in a manner similar to dry electro photography printers, or laser printers. Like a laser printer, a photoconductive drum is charged and is then selectively exposed to a laser to form a charge pattern that corresponds to an image. In LEP printers, the drum is then contacted with a binary ink developer (BID) that selectively transfers a liquid ink pattern to the charge pattern. The liquid ink pattern is transferred from the photoconductive drum to a medium to form the image on the medium.

Referring now to FIG. **1**, an embodiment of a printing device **1000** (shown in phantom) having a BID **100** therein is depicted. Generally, the BID **100** includes a developer roller **12**, a main electrode **114**, a squeegee roller **116**, a cleaning roller **118**, a wiper **120**, a sponge roller **122**, a squeezer roller **124**, and an ink tray **126**.

A potential bias between the main electrode **114** and the developer roller **12** initially transfers charge to the developer roller **12**. The squeegee roller **116** regulates the ink film thickness on the developer roller **12**. Ink is then selectively transferred from the developer roller **12** to charged portions of the photoconductive drum surface (not shown). The cleaning roller **118** substantially removes remaining ink from the developer roller **12**, the wiper **120** cleans the cleaning roller **118**, and the sponge roller **122** cleans the wiper **120**. This cleaning process, in many instances, may substantially minimize sludge buildup.

The embodiment of the BID **100** shown in FIG. **1** may, in some instances, have a relatively limited life, due, at least in part, to wear of its internal parts over time, the relatively limited life of its developer roller **12**, and potential sludge buildup inside the BID **100**.

Embodiment(s) of the present disclosure provide a replaceable developer roller apparatus that is suitable for use in a BID **100** (such as that shown in FIG. **1**) in a printing device **1000**. Without being bound to any theory, it is believed that embodiment(s) of the replaceable developer roller may advantageously extend the life of a BID **100** in which it is used. Upon failure or dissatisfaction with the replaceable developer roller **12**, rather than replacing the entire BID **100**, the roller **12** itself may be replaced.

Referring now to FIG. **2**, an exploded side view of an embodiment of the replaceable developer roller apparatus **10** is depicted. The replaceable developer roller apparatus **10** includes a hollow cylindrical developer roller **12** having two opposed ends **14**, **16**. The perspective view of the hollow cylindrical developer roller **12**, as shown in FIG. **3**, illustrates its hollow, conductive material core **18**. It is to be understood that the core **18** may be made of any conductive material, examples of which include metal(s), plastic with conductive layer(s)/materials thereon and/or therein, and the like. In an embodiment, the core **18** is formed from one or more of aluminum, stainless steel, cold drawn steels with a coating thereon, and/or the like, and/or combinations thereof.

The core **18** may also be covered with a layer **19** of a conductive polymeric material, an example of which are polymeric materials incorporating additives such as metal particles, ionic charged particles, carbon black, graphite, and/or the like, and/or combinations thereof. In an embodiment, layer **19** is formed from a conductive urethane material. In the embodiment depicted in FIG. **3**, the core **18** has an inner tapered wall section **20** located at each of the opposed ends **14**, **16**. Opposed end **16** is generally referred to, but not shown in FIG. **3**, however, opposed end **16** can be a mirror image of opposed end **14**. In an example, each of the inner tapered wall sections **20** has a taper angle ranging from about 3 degrees to about 7 degrees. In a further embodiment, the taper angle is about 5 degrees.

Referring back to FIG. **2**, the replaceable developer roller **10** includes a drive assembly **22** selectively and operatively engageable with one of the opposed ends **14**, **16** of the developer roller **12**. Generally, the drive assembly **22** includes a shaft **24**, a gear **26**, and a frusto-conical drive member **28**.

The shaft **24** of the drive assembly **22** has two opposed regions **30**, **32**. The gear **26**, which has two opposed faces **34**, **36**, is rotationally fixed to one of the opposed regions **30**, **32** of the shaft **24**. It is to be understood that the gear **26** may be a spur gear, a helical gear, a worm gear, or the like. In an example, a helical gear is used as it may advantageously substantially reduce the noise produced by the roller **12** when in use.

The frusto-conical drive member **28** is rotationally fixed to the other of the opposed regions **32**, **30** of the shaft **24**. It is to be understood that the frusto-conical drive member **28** is selectively, axially moveable between an engagement position and a disengagement position (the disengagement position is shown in FIG. **2**). Specifically, in the embodiment depicted in FIG. **2**, the frusto-conical drive member **28** is axially translatable on the drive shaft **24** between the engagement position and the disengagement position. The frusto-conical drive member **28** may be made such that its shape is complementary with the inner tapered wall section **20** of one of the opposed ends **14**, **16** of the developer roller **12**. When moved into the engagement position, the drive member **28** frictionally engages the tapered wall section **20** of opposed end **14** or **16**.

A spring **38** is disposed on the shaft **24** between one of the opposed faces **34**, **36** of the gear **26** and the drive member **28**. Any suitable spring **38** may be used, and in an embodiment, the spring **38** is a compression spring, a helical spring, or the like. It is to be understood that the spring **38** advantageously biases the drive member **28** toward the engagement position.

First and second bearings **40**, **42** are disposed on the drive assembly shaft **24**. One of the first and second bearings **40**, **42** is disposed between the spring **38** and one of the opposed faces **36**, **34** of the gear **26**; while the other of the second and first bearings **42**, **40** is disposed adjacent the other of the opposed faces **34**, **36** of the gear **26**. The bearings **40**, **42** may be roller bearings, sleeve bearings, journal bearings, needle bearings, ball bearings, or the like, and/or combinations thereof. For illustrative purposes, the first bearing **40** is shown between the spring **38** and the opposed face **36**, and the second bearing **42** is shown adjacent the other of the opposed faces **34**.

In an embodiment, a washer **44** may optionally be disposed between the spring **38** and the first bearing **40**. It is to be understood that the washer **44** has a high wear surface such that it may withstand, over time and use, pressure exerted when the apparatus **10** is in use and during replacement of developer roller **12**. In an embodiment where the washer **44** is not desired, it is to be understood that the spring **38** and first bearing **40** may optionally be designed with high wear surfaces to withstand such pressure as desired. Examples of suitable washers **44** include spacer washers, nylon washers, other polymeric washers (examples of which include polypropylene and high density polyethylene), and the like, and/or combinations thereof.

The drive assembly **22** also includes one or more drive member retaining clips **46** matingly engaged within an annular notch (not shown) that is defined in the other of the opposed regions **32**, **30** of the shaft **24**. Generally, the annular notch is defined in the shaft **24** at the region **32** opposed to the region **30** where the gear **26** is rotationally fixed. It is to be understood that the clip(s) **46** is located in a position such that the frusto-conical drive member **28** is substantially prevented from axially disengaging from the shaft **24**. Examples of suitable clip(s) **46** include, but are not limited to, snap rings, C-clips, E-clips, and the like, and/or combinations thereof. In an embodiment, E-clip(s) are used.

The replaceable developer roller apparatus **10** also includes a spindle assembly **48** that is engageable with the other of the opposed ends **16**, **14** of the developer roller **12**. The spindle assembly **48** has a shaft **50** with two opposed regions **52**, **54**. A frusto-conical alignment member **56** is rotationally fixed to the spindle assembly shaft **50** at one of the opposed regions **52**, **54**. In an embodiment, the frusto-conical alignment member **56** may be made such that its shape is complementary with the inner tapered wall section **20** of the other of the opposed ends **16**, **14** of the developer roller **12**. It is to be understood that the frusto-conical alignment member **56** frictionally engages the respective inner tapered wall section **20** when the drive member **28** is in the engagement position.

The spindle assembly **48** may also include a bearing **58** on the shaft **50** between the alignment member **56** and the other of the opposed regions **54**, **52**. It is to be understood that the bearing **58** may be any of the bearings described hereinabove.

Referring now to FIG. **4**, an embodiment of the drive assembly shaft **24** is depicted with an embodiment of the frusto-conical drive member **28**. It is to be understood that in this embodiment, the frusto-conical drive member **28** is axially translatable on the drive shaft **24**. As depicted, the drive assembly shaft **24** is splined at opposed region **32**. A center bore **29** of the drive member **28** is splined complementarily to the splined drive assembly shaft **24**. It is to be further understood that the splined shaft **24** drivingly engages with the drive member **28**.

Referring now to FIG. **5**, an embodiment of the method of replacing the embodiment of the developer roller **12** shown in FIG. **2** in a printing device **1000** is depicted. The method generally includes moving the drive member **28** away from the developer roller **12** and compressing the spring **38**, as shown at reference numeral **60**; moving the developer roller **12** out of engagement with the spindle assembly **48**, as shown at reference numeral **62**; removing the developer roller **12** from apparatus **10**, as shown at reference numeral **64**; and replacing the removed developer roller **12** with a new developer roller **12** by reversing the process, as shown at reference numeral **66**.

More specifically, the method may include axially moving the frusto-conical drive member **28** from its engagement with one of the opposed ends **14**, **16** (end **14** as shown in FIG. **2**) of the developer roller **12**, such that it is disengaged therefrom. In this embodiment of the method, the drive member **28** moves axially independently of the drive shaft **24**. Further, the movement of the drive member **28** to the disengagement position may be accomplished by urging (which may be accomplished manually and/or via a common hand tool with a substantially flat head, such as, for example, a flat head screwdriver and/or the like) the drive member **28** out of the opposed end **14**, **16** and toward the gear **26**. It is to be understood that when the drive member **28** is in the disengagement position, the spring **38** is compressed towards the gear **26**.

When the drive member **28** is in the disengagement position, the other of the opposed ends **16**, **14** (end **16** as shown in FIG. **2**) of the developer roller **12** may be removed such that it is no longer engaging the frusto-conical alignment member **56**. The developer roller **12** may then be removed from the printing device **1000**.

In an alternate embodiment of the method, the developer roller **12** may be urged toward and with the drive member **28** such that the spring **38** is compressed, and the opposed end **16**, **14** disengages from the alignment member **56**. Once the developer roller **12** is disengaged from the alignment member **56**, the other of the opposed ends **14**, **16** may be removed such that it is no longer engaging the frusto-conical drive member **28** of the drive assembly **22**. The developer roller **12** may then be removed from the printing device **1000**.

Once the developer roller **12** is removed from the printing device **1000** using either of the above methods, one of the opposed ends **16**, **14** of a new developer roller **12** may be engaged with the frusto-conical alignment member **56**. The frusto-conical drive member **28** may then be moved axially from the disengagement position such that the other of the opposed ends **14**, **16** of the new developer roller **12** is engaged therewith. Axially moving the drive member **28** to the engagement position may be accomplished by allowing the spring **38** to urge the drive member **28** into the respective opposed end **14**, **16** of the new developer roller **12**.

Alternately, once the developer roller **12** is removed from the printing device **1000** using either of the methods described further above, one of the opposed ends **14**, **16** of a new developer roller **12** may be engaged with the frusto-conical drive member **28** while compressing spring **38**. The frusto-conical alignment member **56** may then be engaged with the other of the opposed ends **16**, **14** of the new developer roller **12** by allowing the spring **38** to urge the drive member **28** and engaged roller end **14**, **16** toward the spindle assembly **48**.

Referring now to FIG. **6**, an alternate embodiment of the replaceable developer roller **10** is depicted. In this embodiment, the frusto-conical drive member **28** is both rotationally and axially fixed to the drive shaft **24** at an end **32**, **30** opposed to the end **30**, **32** where the gear **26** is rotationally fixed. The drive shaft **24** is axially translatable between the engagement position and the disengagement position (the disengagement position is shown in FIG. **6**).

In an example, the gear **26** is rotationally fixed to shaft **24** via a notch (not shown) in gear **26** and a pin (not shown) extending through the notch and into shaft **24**. In a further example, one of the opposed regions **30**, **32** of the drive assembly shaft **24** is splined. A center bore **27** of the gear **26** is also splined such that it is complementary with the splined shaft **24**. It is to be understood that the splined shaft **24** drivingly engages with the gear **26**.

The drive assembly **22** includes a bearing housing **68** having the first bearing **40** therein. The bearing housing **68** is located along the shaft **24** between one of the opposed faces **36**, **34** of the gear **26** and drive member **28**. The bearing housing **68** may recess the optional washer **44** therein and may also recess at least a portion of the spring **38** therein.

In this embodiment, the second bearing **42** is disposed on the shaft **24** between the spring **38** and the drive member **28**. In an example, the first bearing **40** is a roller bearing, a journal bearing, a needle bearing, or the like; and the second bearing **42** is a needle bearing, a journal bearing, or the like.

A selectively engageable locking mechanism **70** selectively, axially locks the drive assembly shaft **24** in the disengagement position. Examples of suitable locking mechanisms **70** include pin/aperture mechanisms, cams, threaded members, locking levers, and/or the like.

As shown in FIG. **6**, the spindle assembly **48** may optionally include a washer **44** disposed on the spindle assembly shaft **50** between the bearing **58** and the opposed region **54**. While the washer **44** is not depicted in the spindle assembly **48** of FIG. **2**, it is to be understood that the washer **44** may be used in any of the embodiments of the spindle assembly **48** disclosed herein.

Referring now to FIG. **7**, an embodiment of the method of replacing the embodiment of the developer roller **12** shown in FIG. **6** in a printing device **1000** is depicted. The method generally includes moving the drive shaft **24** away from the developer roller **12** and locking the lock mechanism **70**, as shown at reference numeral **72**; moving the developer roller **12** out of engagement with the spindle assembly **48**, as shown at reference numeral **74**; removing the developer roller **12** from the apparatus **10**, as shown at reference numeral **76**; and replacing the removed developer roller **12** with a new developer roller **12** by reversing the process, as shown at reference numeral **78**.

More specifically, the method includes axially moving the frusto-conical drive member **28** with the drive shaft **24** from its engagement with one of the opposed ends **14**, **16** of the developer roller **12**, such that it is disengaged therefrom. In this embodiment of the method, the movement of the drive member **28** and drive shaft **24** to the disengagement position may be accomplished by urging/pulling (which may be accomplished manually) the drive shaft **24** and drive member **28** out of the respective opposed end **14**, **16** of the developer roller **12**. The drive shaft **24** may then be locked in the disengagement position via the locking mechanism **70**.

When the drive shaft **24** is locked in the disengagement position, the other of the opposed ends **16**,**14** of the developer roller **12** may be removed such that it is no longer engaging the frusto-conical alignment member **56** of the spindle assembly **48**. The developer roller **12** may then be removed from the printing device **1000**.

Once the developer roller **12** is removed from the printing device **1000**, one of the opposed ends **16**, **14** of a new developer roller **12** may be engaged with the frusto-conical alignment member **56**. The drive shaft **24** may then be unlocked and the drive member **28** moved axially from the disengagement position such that the other of the opposed ends **14**, **16** of the new developer roller **12** is engaged therewith. Axially moving the drive shaft **24** to the engagement position may be accomplished by unlocking the lock mechanism **70** and allowing the spring **38** to urge the drive member **28** into the respective one of the opposed ends **14**, **16** of the new developer roller **12**.

Embodiment(s) of the present disclosure may advantageously be used in a printing device **1000** in order to extend the life of the BID **100** within that printing device **1000**.

While several embodiments have been described in detail, it will be apparent to those skilled in the art that the disclosed embodiments may be modified. Therefore, the foregoing description is to be considered exemplary rather than limiting.

What is claimed is:

1. A replaceable developer roller apparatus for a printing device, the apparatus comprising:

a cylindrical developer roller having two opposed ends;

a drive assembly selectively and operatively engageable with one of the opposed ends of the developer roller, the drive assembly including:

a shaft having two opposed regions;

a gear rotationally fixed to one of the opposed regions of the shaft; and

a drive member rotationally fixed to the other of the opposed regions of the shaft, and selectively, axially moveable between an engagement position and a disengagement position; and a spindle assembly engageable with the other of the opposed ends of the developer roller, the spindle assembly including:

a spindle assembly shaft; and

an alignment member rotationally fixed to the spindle assembly shaft.

2. The apparatus as defined in claim 1 wherein the cylindrical developer roller comprises a hollow conductive material core having an inner tapered wall section at each of the two opposed ends.

3. The apparatus as defined in claim 2 wherein the conductive material core comprises at least one of metals, plastics with conductive material established thereon, and combinations thereof.

4. The apparatus as defined in claim 2 wherein each of the inner tapered wall sections has a taper angle ranging from about 3 degrees to about 7 degrees.

5. The apparatus as defined in claim 2 wherein the developer roller further comprises a conductive polymeric layer established on the hollow conductive material core.

6. The apparatus as defined in claim 2 wherein the drive member is complementarily shaped with the inner tapered wall section of the one of the opposed ends and frictionally engages therewith in the engagement position, and wherein the alignment member is complementarily shaped with the inner tapered wall section of the other of the opposed ends and frictionally engages therewith when the drive member is in the engagement position.

7. The apparatus as defined in claim 1 wherein the drive member is biased toward the engagement position.

8. The apparatus as defined in claim 7 wherein a spring, operatively disposed between the gear and the drive member on the shaft, biases the drive member toward the engagement position.

9. The apparatus as defined in claim 1 wherein the drive member is axially translatable on the shaft between the engagement position and the disengagement position.

10. The apparatus as defined in claim 9 wherein the gear has two opposed faces, and wherein the drive assembly further comprises:

a spring disposed between one of the opposed faces of the gear and the drive member on the shaft, the spring biasing the drive member toward the engagement position;

a first bearing disposed between the spring and the one of the opposed faces of the gear;

a second bearing disposed on the shaft and adjacent the other of the opposed faces of the gear; and

at least one drive member retaining clip matingly engaged within an annular notch defined in the other of the opposed regions of the shaft, the at least one clip at a position adapted to prevent the drive member from axially disengaging from the shaft.

11. The apparatus as defined in claim 10, further comprising a washer disposed between the spring and the first bearing.

12. The apparatus as defined in claim 10 wherein the first and second bearings are each roller bearings, sleeve bearings, needle bearings, ball bearings, journal bearings, or combinations thereof.

13. The apparatus as defined in claim 9 wherein the spindle assembly shaft has two opposed regions, wherein the alignment member is rotationally fixed to the spindle assembly shaft at one of the opposed regions, and wherein the spindle assembly further comprises a bearing disposed on the spindle assembly shaft between the alignment member and the other of the opposed regions.

14. The apparatus as defined in claim 9 wherein the other of the opposed regions of the shaft is splined, wherein a center bore of the drive member is splined complementarily to the splined shaft, and wherein the splined shaft drivingly engages with the drive member.

15. The apparatus as defined in claim 1 wherein the drive member is both rotationally and axially fixed to the shaft, and wherein the shaft is axially translatable between the engagement position and the disengagement position.

16. The apparatus as defined in claim 15 wherein the gear has two opposed faces, and wherein the drive assembly further comprises:

a spring disposed between one of the opposed faces of the gear and the drive member on the shaft, the spring biasing the drive member toward the engagement position;

a bearing housing having a first bearing therein and disposed between the one of the opposed faces of the gear and the drive member, the bearing housing adapted to recess a washer therein, and adapted to recess at least a portion of the spring therein;

a second bearing disposed on the shaft between the spring and the drive member; and

a selectively engageable locking mechanism adapted to axially lock the shaft in the disengagement position.

17. The apparatus as defined in claim 16, further comprising a washer disposed between the spring and the first bearing.

18. The apparatus as defined in claim 16 wherein the first bearing is one of a roller bearing, a journal bearing, and a needle bearing, and wherein the second bearing is one of a needle bearing and a journal bearing.

19. The apparatus as defined in claim 15 wherein the spindle assembly shaft has two opposed regions, wherein the alignment member is rotationally fixed to the spindle assembly shaft at one of the opposed regions, and wherein the spindle assembly further comprises:

a bearing disposed on the spindle assembly shaft between the alignment member and the other of the opposed regions; and

a washer disposed on the spindle assembly shaft between the bearing and the other of the opposed regions.

20. The apparatus as defined in claim 15 wherein the gear is rotationally fixed to the shaft.

21. The apparatus as defined in claim 1 wherein at least a portion of at least one member selected from the drive member and the alignment member has a frusto-conical shape.

22. A method of replacing a developer roller in a printing device, the method comprising:

axially moving a drive member from engagement with one of two opposed ends of a cylindrical developer roller to disengage therefrom, the drive member being part of a drive assembly including a shaft having two opposed regions; a gear rotationally fixed to one of the opposed regions of the shaft; and the drive member rotationally fixed to the other of the opposed regions of the shaft;

removing the other of the opposed ends of the developer roller from engagement with an alignment member, the alignment member being part of a spindle assembly including a spindle assembly shaft and the alignment member being rotationally fixed to the spindle assembly shaft;

engaging an other of two opposed ends of a new developer roller with the alignment member; and axially moving the drive member from disengagement with one of the opposed ends of the new developer roller to engagement therewith.

23. The method as defined in claim **22** wherein the drive member moves axially either independently of the shaft or with the shaft.

24. The method as defined in claim **23** wherein the drive member moves axially independently of the shaft, and wherein the axially moving to disengagement is accomplished by urging the drive member out of the one of the opposed ends of the developer roller and toward the gear.

25. The method as defined in claim **24** wherein the urging is accomplished by a tool.

26. The method as defined in claim **24** wherein the gear has two opposed faces, wherein the drive assembly further comprises:

a spring disposed between one of the opposed faces of the gear and the drive member on the shaft, the spring biasing the drive member toward the engagement position;

a first bearing disposed between the spring and the one of the opposed faces of the gear;

a second bearing disposed on the shaft and adjacent the other of the opposed faces of the gear; and

at least one drive member retaining clip matingly engaged within an annular notch defined in the other of the opposed regions of the shaft, the at least one clip at a position adapted to prevent the drive member from axially disengaging from the shaft;

and wherein the axially moving to engagement is accomplished by allowing the spring to urge the drive member into the one of the opposed ends of the developer roller.

27. The method as defined in claim **23** wherein the drive member moves axially with the shaft, and wherein the axially moving to disengagement is accomplished by urging the drive member out of the one of the opposed ends of the developer roller and then locking the shaft in the disengagement position.

28. The method as defined in claim **27** wherein the urging is accomplished manually.

29. The method as defined in claim **27** wherein the gear has two opposed faces, and wherein the drive assembly further comprises:

a spring disposed between one of the opposed faces of the gear and the drive member on the shaft, the spring biasing the drive member toward the engagement position;

a bearing housing having a first bearing therein and disposed between the one of the opposed faces of the gear and the drive member, the bearing housing adapted to recess at least a portion of the spring therein;

a second bearing disposed on the shaft between the spring and the drive member; and

a selectively engageable locking mechanism adapted to axially lock the shaft in the disengagement position;

and wherein the axially moving to engagement is accomplished by unlocking the shaft and allowing the spring to urge the drive member into the one of the opposed ends of the developer roller.

30. The method as defined in claim **22** wherein at least a portion of at least one member selected from the drive member and the alignment member has a frusto-conical shape.

31. A method for removing a developer roller from a printing device, the method comprising:

axially moving a frusto-conical drive member from engagement with one of two opposed ends of a hollow cylindrical developer roller to disengage therefrom, the frusto-conical member being part of a drive assembly including a shaft having two opposed regions; a gear rotationally fixed to one of the opposed regions of the shaft; and the frusto-conical drive member rotationally fixed to the other of the opposed regions of the shaft;

removing the other of the opposed ends of the developer roller from engagement with a frusto-conical alignment member, the alignment member being part of a spindle assembly including a spindle assembly shaft and the frusto-conical alignment member rotationally fixed to the spindle assembly shaft; and

removing the developer roller from the printing device.

32. A printing device, comprising:

a replaceable developer roller apparatus, including:

a cylindrical developer roller having two opposed ends;

a drive assembly selectively and operatively engageable with one of the opposed ends of the developer roller, the drive assembly including:

a shaft having two opposed regions;

a gear rotationally fixed to one of the opposed regions of the shaft; and

a frusto-conical drive member rotationally fixed to the other of the opposed regions of the shaft, and selectively, axially moveable between an engagement position and a disengagement position; and

a spindle assembly engageable with the other of the opposed ends of the developer roller, the spindle assembly including:

a spindle assembly shaft; and

a frusto-conical alignment member rotationally fixed to the spindle assembly shaft.

33. The printing device as defined in claim **32** wherein the printing device is a liquid electro photography (LEP) printer.

34. A developer roller for use in a printing device, the roller comprising:

a hollow, cylindrical core having two opposed ends; and

an inner, tapered wall section defined at each of the opposed ends of the core, wherein one of the opposed end tapered wall sections is adapted to frictionally engage a complementarily shaped frusto-conical drive member, and wherein the other of the opposed end tapered wall sections is adapted to frictionally engage a complementarily shaped frusto-conical alignment member;

wherein the frusto-conical drive member is part of a drive assembly, including:

a shaft having two opposed regions;

a gear rotationally fixed to one of the opposed regions of the shaft, the frusto-conical drive member being rotationally fixed to the other of the opposed regions of the shaft, and selectively, axially moveable between an engagement position and a disengagement position.

35. The developer roller as defined in claim **34** wherein the frusto-conical alignment member is part of a spindle assembly, including a spindle assembly shaft, wherein the frusto-conical alignment member is rotationally fixed to the spindle assembly shaft.

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